DRAFT

TOTAL MAXIMUM DAILY LOAD (TMDL)

For

Sediment

In Savannah River Basin

Franklin, Hart, and Madison Counties, Georgia

Prepared by:

US EPA Region 4
61 Forsyth Street SW
Atlanta, Georgia 30303

August 2004

TMDL SUMMARY / SIGNATURE SHEET

SEDIMENT / Savannah River Basin
Franklin, Hart, and Madison Counties, Georgia
HUC 03060102, 03060104

In 1998, EPA Region 4 placed several streams in the Savannah River Basin on the State of Georgia's Section 303(d) list as impaired due to biota, sediment and habitat. A designation of "biota" reflects impacted biological community and further studies are needed to determine factor(s) causing impairment. These streams were originally placed on the 303(d) list in response to requirements of the settlement agreement of the Georgia "TMDL" lawsuit (Sierra Club v. EPA & Hankinson; No. 194-CV-2501-MHS, N.D.GA). The settlement agreement required a stream to be listed unless data expressly demonstrated the stream supported water quality standards.

EPA Science and Support Division (SESD) conducted field investigations in 2003 - 2004 to assess habitat conditions of the targeted waters and to identify reference streams with "healthy" habitat. The waterbodies requiring TMDLs and the listed impairment(s) include: South Creek/Biger Creek (one listing for biota and habitat), Crawford Creek (one listing for biota), Little Crawford Creek (one listing for biota and habitat), and Shoal Creek (impaired for habitat). Crawford Creek, Little Crawford Creek, and Shoal Creek are tributaries to Lake Hartwell and are considered one listing on the 303(d) list.

The TMDLs presented herein are based on the hypothesis that if the impaired waterbodies have a long-term annual sediment load similar to the reference stream, then the impacted waterbodies will remain stable and not be impaired due to sediment. Watershed-scale loading of sediment in water was simulated using the Watershed Characterization System (EPA, 2001) for both the impaired and reference streams. The TMDLs are expressed in terms of average annual loads as summarized in the TMDL Summary Table. Average annual watershed loads represent the long-term processes of accumulation of sediments in the stream habitat areas that are associated with the potential for habitat alteration and aquatic life effects.

The TMDLs assign wasteload allocations (WLA) to dischargers with NPDES permits. NPDES activities include municipal and industrial facilities, and stormwater discharge from MS4 and construction activities. There are no NPDES facilities discharging in the watersheds of the impaired waters. The impaired waters are located in rural watersheds outside of MS4 municipalities. NPDES construction activities are considered a significant source of sediment and are the only component of the WLA. Compliance with the State of Georgia's Storm Water General Permit should lead to sediment loadings from construction sites at or below applicable targets.

Nonpoint sources of sediment are considered the major sediment producing areas in the watershed. These sources include road crossings, agriculture, and bare ground (non-permitted construction type sites, etc.). Instream erosion processes (i.e., stream bank and streambed erosion) can be a significant source of sediment in the impaired creeks, but data were not available to confirm or quantify this.

TMDL SUMMARY

Waterbody Segment / 303(d) Listing ID	Drainage Area (mi^2)	Wasteload Allocation[1] (tons/yr)	Load Allocation (tons/yr)	TMDL (tons/yr)	Percent Reduction
South Creek/Biger Creek (GA-SV-South_Biger Creeks)	36.4	0	5790	5790	39%
Crawford Creek (GA-SV-Crawford_Creek)	7.2	0	1150	1150	63%
Little Crawford Creek (GA-SV-Little_Crawford_Creek)	2.7	0	423	423	48%
Shoal Creek (GA-SV-Shoal Creek)	29.7	0	4711	4711	66%

Notes:

1. Wasteload allocation shown is for continuous discharge facilities; construction activities regulated under the NPDES program are required to comply with the conditions outlined in their permits.

Table of Contents

List of Tables

List of Figures

1. Introduction

TMDLs are required for impaired waters on a State's Section 303(d) list as required by the Federal Clean Water Act Section 303(d) and implementing regulation 40 CFR 130. A TMDL establishes the maximum amount of a pollutant a waterbody can assimilate without exceeding the applicable water quality standard. The TMDL then allocates the total allowable load to individual sources or categories of sources through wasteload allocations (WLAs) for point sources, and through load allocations (LAs) for non-point sources. In the TMDL, the WLAs and LAs provide a basis for states to reduce pollution from both point and non-point source activities that will lead to the attainment of water quality standards and protection of the designated use.

The TMDLs for the listed streams in the Savannah River Basin are shown in Table 1 and satisfy the consent decree obligation established in Sierra Club v. EPA, Civil Action No: 94-CV-2501-MHS (N.D.GA). The Consent Decree requires TMDLs to be developed for all waters on Georgia's most current Section 303(d) list consistent with the schedule established by Georgia for its rotating basin management approach.

As part of the settlement agreement, the State of Georgia, and subsequently EPA Region 4, was required to gather data to determine the status of waters in groups of watersheds for possible inclusion on the Georgia 303(d) list. The identification of watersheds was based on the USDA, Soil Conservation Service's report *"Georgia's Watershed Agricultural Nonpoint Source Pollution Assessment"* (USDA, 1993). Screening level bioassessments and habitat evaluation of 89 watersheds were conducted by staff from EPA Region 4 and Georgia Environmental Protection Division (EPD) in 1996 and 1997 and appropriate additions to the State's 1998 303(d) list were made.

In 2001, EPA Region 4 Science and Support Division (SESD) conducted further investigations of the streams in the Savannah and Ogeechee River Basins. The objective of the field study was to assess habitat conditions of waters in these basins. SESD scientist collected macroinvertibrate samples and qualitative assessment of stream habitat in accordance with rapid bioassessment protocols (Barbour et.al., 1999). Based on the results of the field investigation, four waterbodies in the Savannah River basin were identified as poor habitat and required a TMDL. The 303(d) listings of these nine streams are shown in Table 1.

Table 1. Summary of 303(d) Listings

Waterbody	303(d) Listing ID	County	Parameter
South Creek/Biger Creek	GA-SV-South_Biger_Creeks	Madison	Biota, Sediment
Crawford Creek	GA-SV-Crawford_Creek	Franklin and Hart	Biota
Little Crawford Creek	GA-SV-Little_Crawford_Creek	Franklin and Hart	Biota, Habitat
Shoal Creek	GA-SV-Shoal_Creek	Franklin and Hart	Habitat

2. Watershed Characterization

The locations of the listed streams and the reference streams in the Savannah River Basin are shown in Figure 1 and Figure 2. The drainage areas discharging to the listed streams are identified in these figures and are based on the State of Georgia's Environmental Protection Division (EPD) Hydrologic Unit Code (HUC) level 12 watershed boundaries.

Landuse characteristics for the watershed of the impaired and reference streams are shown in Table 2. Land use is based on the National Land Cover Database (NLDC) of 1995. As shown in this table, forest and agriculture (e.g., cropland and pasture) are the primary land covers in the watersheds.

The following sections summarize field studies conducted by SESD. The purpose of the field studies was to characterize the habitat of the impaired waterbodies and to determine appropriate reference sites within the ecoregion of the impaired streams. An ecoregion is a region of relative homogeneity in ecological systems. The State of Georgia is divided into seven major ecoregions based upon soil types, potential natural vegetation, land surface forms, and predominate land uses. The TMDLs described in this report are in the Piedmont ecoregion (45). Complete details of these assessements are included in the administrative record of the TMDLs.

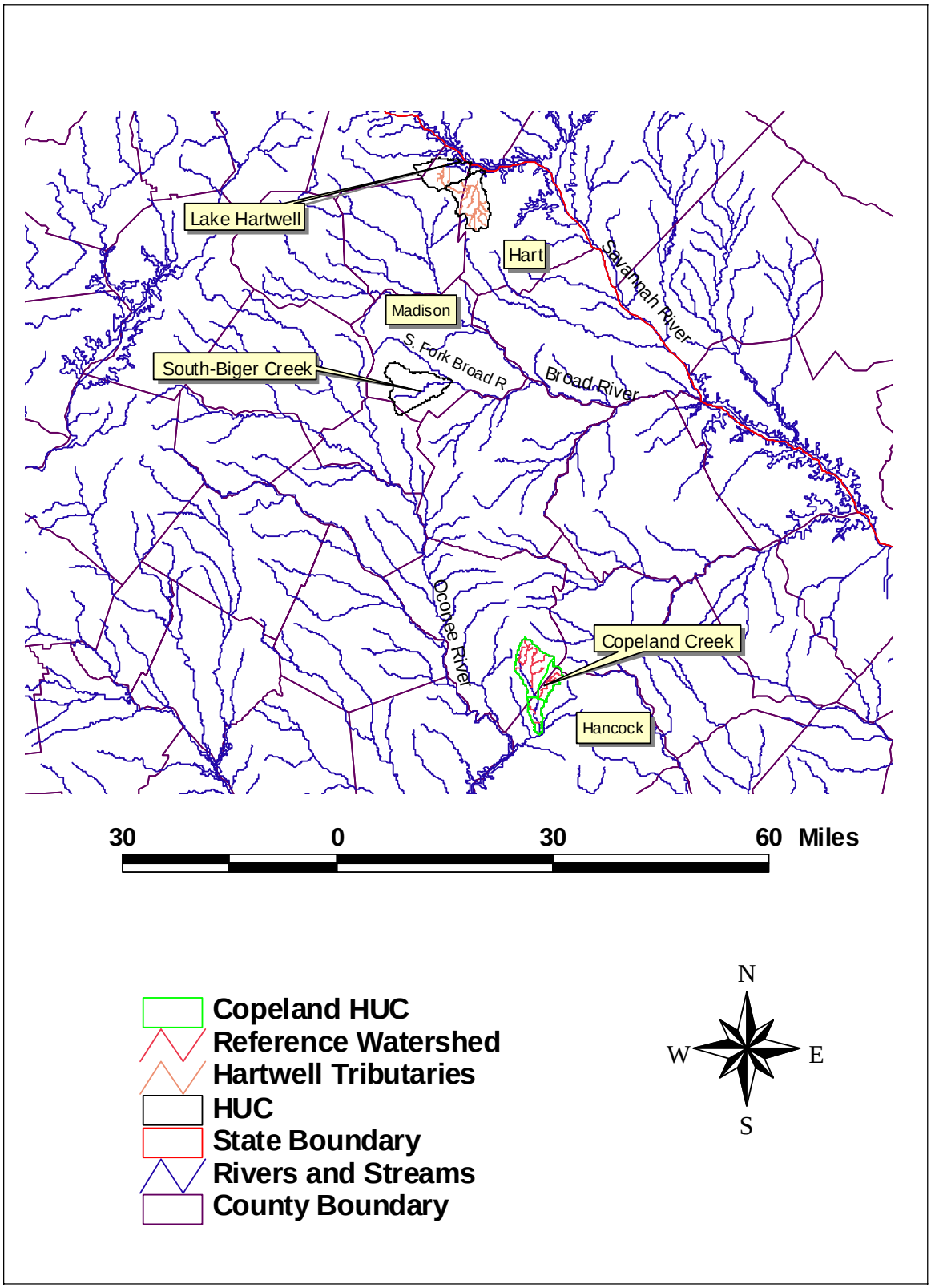

Figure 1. Location of listed waterbodies in Savannah River Basin

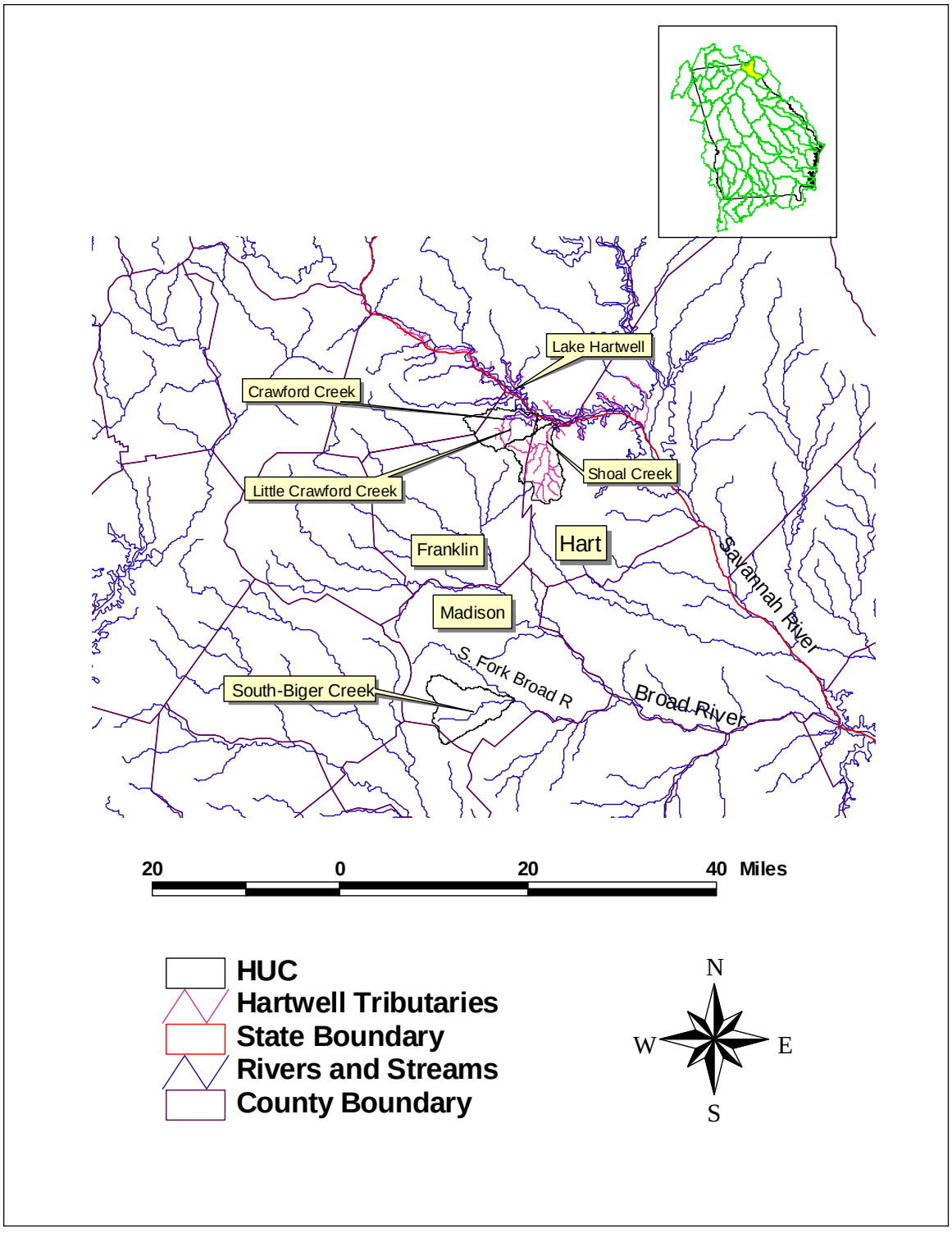

Figure 2. Location of Lake Hartwell Tributaries

Table 2. Landuse Characteristics (acres)

Waterbody	Urban	Barren, Transitional	Commercial, Industry	Agriculture (cropland and pasture)	Water	Wetlands	Forest	Total
South Creek/Biger Creek	658	159	118	7130	158	0	15,084	23,308
Crawford Creek	9	0	61	1048	58	0	2194	3368
Little Crawford Creek	3	0	0	445	11	0	1243	1702
Shoal Creek	431	0	134	9253	171	0	8973	18962
Copeland Creek (reference stream)	21	0	1	1136	15	0	4808	5981

2.1. South Creek/Biger Creek

South Creek/Biger Creek, referred to as Upper South Fork Broad River during the field investigations, lies northwest of Athens, Georgia in Madison County. The river lies with the Southern Outer Piedmont Ecoregion (45b) in the state of Georgia. The ecoregion is characterized by rolling hills and is mostly forested with loblolly-shortleaf pine being the major type, with some oak-hickory and oak-pine areas. Open areas, such as pastures and croplands, are common.

The stream was sampled at GA-172 near Comer, Georgia. A physical habitat survey indicated heavy sedimentation, poor bank stability, marginal vegetative protection along the banks and serious human impacts to the riparian zone. Results of the biological community investigation indicated moderate impairment and sedimentation was identified as the likely cause.

2.2. Crawford Creek

Crawford Creek is a tributary of Lake Hartwell, a large impoundment on the Savannah River northeast of Atlanta along the Georgia-South Carolina border. The creek lies with the Southern Outer Piedmont Ecoregion (45b) in the state of Georgia. The ecoregion is characterized by rolling hills and is mostly forested with loblolly-shortleaf pine being the major type, with some oak-hickory and oak-pine areas. Open areas, such as pastures and croplands, are common.

Crawford Creek was sampled at New Town Road. A physical habitat survey did not indicate any conditions below the sub-optimal range. Some sedimentation was noted, aw well as minor erosion along banks and some human impact in the riparian zone. However, no major problems were found by the physical habitat survey. Habitats available included leaf packs, undercut banks, woody debris, pools and riffles. Results of the biological community investigation indicated impairment.

2.3. Little Crawford Creek

Little Crawford Creek is a tributary of Lake Hartwell, a large impoundment on the Savannah River northeast of Atlanta along the Georgia-South Carolina border. The creek lies with the Southern Outer Piedmont Ecoregion (45b) in the state of Georgia. The ecoregion is characterized by rolling hills and is mostly forested with loblolly-shortleaf pine being the major type, with some oak-hickory and oak-pine areas. Open areas, such as pastures and croplands, are common.

Little Crawford Creek was sampled at New Town Road. A physical habitat survey indicated some impairment. Sediment deposition, lack of velocity/depth regimes and human impacts within the riparian zone were identified as issues of concern. Results of the biological community investigation indicated impairment.

2.4. Shoal Creek

Shoal Creek, also referred to as Flat Shoals Creek during the field investigation, is a tributary of Lake Hartwell. The creek lies with the Southern Outer Piedmont Ecoregion (45b) in the state of Georgia. The ecoregion is characterized by rolling hills and is mostly forested with loblolly-shortleaf pine being the major type, with some oak-hickory and oak-pine areas. Open areas, such as pastures and croplands, are common.

Shoal Creek was sampled along Beacon Light Road. A physical habitat survey indicated heavy sedimentation and moderately unstable banks as concerns in the river. Obvious potential for non-point source pollution and erosion was identified. Habitats available at both sites included leaf packs, undercut banks, woody debris and one riffle. Results of the biological community investigation indicated impairment and degradation of habitat conditions was identified as the likely cause.

2.5. Copeland Creek (reference stream)

Copeland Creek lies southeast of Greensboro, Georgia and drains an area east of Lake Oconee in Hancock County. It joins with the Oconee River above Lake Sinclair. The Creek lies with the Southern Outer Piedmont Ecoregion (45b) in the state of Georgia. The ecoregion is characterized by rolling hills and is mostly forested with loblolly-shortleaf pine being the major type, with some oak-hickory and oak-pine areas. Open areas, such as pastures and croplands, are common.

Copeland Creek was sampled upstream of GA-15/77. A physical habitat survey indicated a range of habitat conditions present with most parameters scoring in the optimal to suboptimal range. The survey documented minimal sediment deposition, a diversity of velocity and depth regimes, and the presence of optimal epifaunal substrate, mostly stable stream banks and adequate vegetation cover. Results of the biological community investigation indicated the stream is in good condition.

3. Target Identification

3.1 Numerical Target

The water use classification for the impaired waterbodies is fishing. The fishing classification, as stated in Georgia's Rules and Regulations for Water Quality Control Chapter 391-3-6-.03(6)(c), is established to protect the "[p]ropogation of Fish, Shellfish, Game and Other Aquatic Life; secondary contact recreation in and on the water; or for any other use requiring water of a lower quality".

GAEPD has established narrative criteria for sediment that applies to all waters of the State. Georgia Regulation 391-3-6-.03(5)(e) of Georgia's Rules and Regulations for Water Quality Control states that "[a]ll waters shall be free from material related to municipal, industrial, or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses".

3.2 Target Selection

The TMDLs presented herein are based on the hypothesis that if the impaired waterbodies have a long-term annual sediment load similar to a biologically unimpacted, healthy stream in the same ecoregion, then the impacted waterbodies will remain stable and not be biologically impaired due to sediment. Field investigations conducted by EPA Region 4 SESD identified Copeland Creek to have habitat of acceptable quality and a macroinvertebrate community that is not adversely impacted by sediment.

The criteria SESD used in selecting the reference sites included: 1) level of human disturbance; 2) accessibility; 3) representativeness; and 4) health of the stream. Other considerations included lack of permitted discharges, landuse classification, and good riparian conditions. SESD collected macroinvertebrate samples to provide additional information on water quality conditions.

Habitat assessments were completed for the reference sites as well as the listed streams. The habitat assessment evaluates the stream's physical parameters and is broken in three levels: 1) instream characteristics affecting biological communities (e.g., instream cover, epifaunal substrate, embeddedness, and riffle frequency); 2) channel morphology, and 3) riparian zone surrounding the stream. Results of the habitat assessment are shown in Table 3.

Table 3. Habitat Scores for Impaired and Reference Streams

Waterbody	Epifaunal Substrate	Velocity/ Depth	Embeddedness	Riffle Frequency	Channel Alteration	Sediment Deposition	Channel Flow Status	Bank Vegetation (left)	Bank Vegetationj (right)	Bank Stability (left)	Bank Stability (right)	Riparian Zone (left)	Riparian Zone (right)	Habitat Total
Crawford Creek	15	14	15	17	18	18	16	9	9	8	9	9	7	164
Little Crawford Creek	13	9	8	10	18	10	15	9	9	9	6	10	5	131
Shoal Creek	14	9	5	8	18	2	10	9	9	5	5	10	10	114
South/Biger Creek	13	16	6	6	18	5	19	3	3	2	2	9	2	104
Copeland Creek (reference)	19	15	19	19	19	14	15	9	4	8	3	8	10	162

The target load in the ecoregion was based on research conducted by the U.S. Department of Agriculture (USDA), Agricultural Research Service National Sedimentation Laboratory (ARS-NSL). Under contract with EPA, ARS-NSL developed average annual sediment yields for ecoregions in Region 4. Mean daily flow and suspended sediment data collected at U.S. Geological Survey (USGS) sites were used to generate sediment yield rating curves. The NSL conducted rapid geomorphic assessments (RGAs) at the USGS sites to evaluate the channel stability of the sites and then ranked the sites as either stable or unstable. Values of sediment yield at the stable sites in ecoregion 45 are shown in Figure 3.

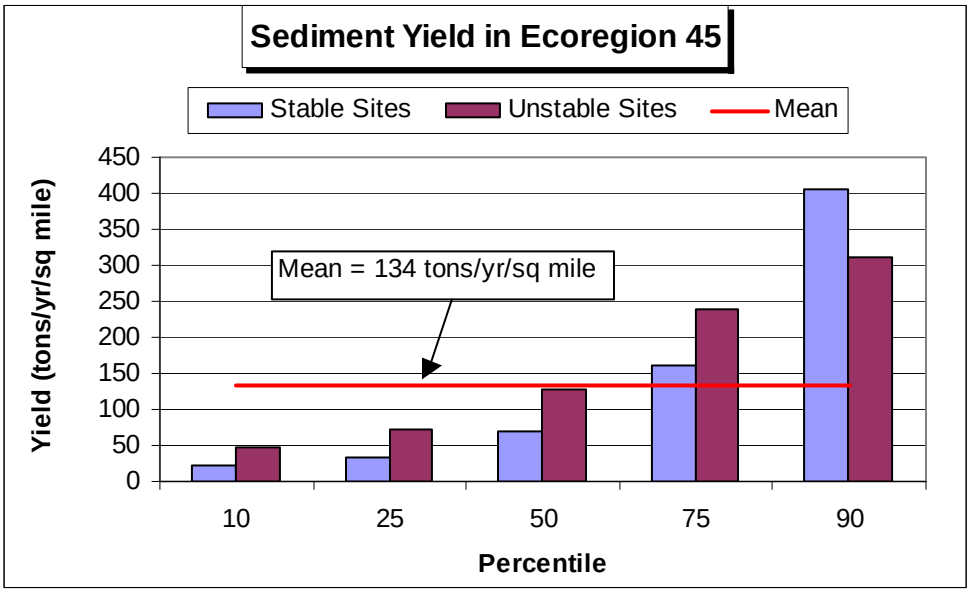

Figure 3. Sediment Yield in the Piedmont Ecoregion (45)

4. Modeling Approach

EPA and Tetra Tech developed the Arcview-based Watershed Characterization System (WCS) to provide tools for characterizing various watersheds (EPA, 2001a). WCS was used to display and analyze geographic information system (GIS) data including landuse, soil type, ground slope, road networks, NPDES discharges, and watershed characteristics. An extension of WCS is the Sediment Tool, which provides a mechanistic, simplistic simulation of precipitation-driven runoff and sediment delivery based on the Universal Soil Loss Equation (USLE).

The USLE equation is designed as a method to predict average annual soil loss caused by sheet and rill erosion. While it can estimate long-term annual soil loss and guide on proper cropping, management, and conservation practices, it cannot be applied to a specific year or storm event. A summary of USLE input parameters used to estimate the watershed loadings is provided in Appendix A. Details of the WCS Sediment Tool are documented in the TMDL developed for sediment in Headstall Creek in the Savannah River Basin (GAEPD, 2004).

The WCS Sediment Tool assumes all the sediment in the stream originates from the watershed. For streams characterized by extremely unstable banks the Sediment Tool may underestimate the load, as sediment originating from streambank sloughing may be a major source of sediment as compared to the loadings from the watershed. Therefore, the WCS Sediment Tool provides an estimate of the chronic, or long-term, impact of sediment discharging from the watershed and represent average conditions during all seasons.

The Sediment Tool divides the watershed into a grid network based on elevation data (30 by 30 meter data). For each grid cell within the watershed, the Sediment Tool calculates the potential erosion using the USLE and each cell's specific characteristics. The model routes the sediment through each grid cell until it reaches the stream. The stream grid network incorporates flow and has the capability of accumulating flow.

The amount of sediment reaching the stream is controlled primarily by the stream grid value, which defines the density of cells upstream of the stream's headwater cell. The stream grid value parameter was adjusted until the annual sediment load in the reference stream approximated the load in stable streams in the ecoregion.

A stream grid value of 25 resulted in a sediment yield in Copeland Creek of 496 lb/acre/yr. This yield compares favorable with the 75^{th} quartile of the ecoregion loads (i.e., 502 lb/acre/yr) and represents the maximum load a stable stream can transport. The assumption in this TMDL is a stable stream will support healthy habitat while maintaining the stream's designated use. The model input parameters used to calibrate loadings transported in the reference stream were used to calculate the existing loads in the impaired streams.

5. Source Assessment

A TMDL evaluation examines the known potential sources of the pollutant in the watershed, including point sources, nonpoint sources, and background levels. For the purpose of these TMDLs, facilities under the National Pollutant Discharge Elimination System (NPDES) Program are considered point sources.

5.1 Point Sources

Discharge from municipal and industrial facilities may contribute biologically active and inert solids to receiving waters as TSS and/or turbidity. There are no NPDES discharges in the impaired watersheds.

Soil erosion from construction sites is a major source of sediment in Georgia's streams. The State of Georgia requires construction sites over one acre to have a General Storm Water NPDES permit. The permit authorize the discharge of storm water associated with

construction activity in accordance with the limitations, monitoring requirements, and other conditions set forth in the permit. All construction sites are required to have an Erosion and Sediment Control Plan; to implement, inspect, and maintain BMPs; and to monitor storm water for turbidity. The permit can be considered a water quality-based permit, in that the numerical limits in the permit, if met and enforced, will not cause a water quality problem in an unimpaired stream or contribute to an existing problem in an impaired stream.

5.2 Nonpoint Sources

Roads, agriculture, bare ground (i.e., non-permitted construction type sites, etc.), and silviculture are the major nonpoint source of sediment in the watersheds. During the habitat assessment investigation, it was documented that several of the impaired waterbodies have unstable banks and lack vegetation on the streambanks. Undercutting of the streambed and banks can be a major nonpoint source of sediment during high flow events. Construction and nonpoint sources are considered the primary source of sediment in the impaired waterbodies.

Sediment loadings in the impaired streams based on results of the WCS Sediment Tool analysis are shown in Table 4.

Table 4. Estimated Sediment Loadings for Existing (chronic) Conditions

Waterbody	Drainage Area (mi^2)	Yield ($tons/mi^2/yr$)	Total Load (tons/yr)
South Creek/Biger Creek	36.4	263	9,581
Crawford Creek	7.2	432	3,128
Little Crawford Creek	2.7	309	824
Shoal Creek	29.6	471	13,952

6. Total Maximum Daily Load (TMDL)

A TMDL establishes the total pollutant load a waterbody can assimilate and still achieve water quality standards. The components of a TMDL include a wasteload allocation (WLA) for point sources, a load allocation (LA) for nonpoint sources (including natural background), and a margin of safety (MOS), either implicitly or explicitly, to account for uncertainty in the analysis. Conceptually, a TMDL is defined by the equation:

$$TMDL = \Sigma WLA + \Sigma LA + MOS$$

The TMDLs for the Savannah River Basin streams are expressed in terms of sediment yield, in units of $tons/mi^2/yr$, based on average annual area-weighted loads calculated using the WCS Sediment Tool. It is acceptable for TMDLs to be expressed through other appropriate measures (e.g., sediment yield) other than mass loads per time (40 CFR

130.2). The TMDLs are also expressed as total annual loads as several of the streams have NPDES facilities discharging sediment and permit limits are expressed in units of mass loads per time. TMDL components are shown in Table 5.

Table 5. TMDL Components

Waterbody Segment	Wasteload Allocation[1] (tons/yr)	Load Allocation[2] (tons/yr)	TMDL (tons/yr)	Percent Reduction
South Creek/Biger Creek	0	5790	5790	39%
Crawford Creek	0	1150	1150	63%
Little Crawford Creek	0	423	423	48%
Shoal Creek	0	4711	4711	66%

Notes:

1. Wasteload allocation shown is for continuous discharge facilities; construction activities regulated under the NPDES program are required to comply with the conditions outlined in their permits.
2. Load Allocation based on an area weighted sediment load of 159 tons/mi^2/yr estimated for stable streams in the ecoregion

6.1 Wasteload Allocation (WLA)

Wasteload allocations are provided to point source discharge from industrial and municipal facilities as well as permitted stormwater discharges. There are no industrial or municipal NPDES facilities continuously discharging sediment into the impaired streams.

Compliance with the Georgia Storm Water Permit will ensure construction sites meet the TMDL area weighted loadings. EPA assumes that construction activities in the watershed will be conducted in compliance with Georgia's Storm Water Permit including monitoring and discharge limitations. Compliance with these permits should lead to sediment loadings from construction sites at or below applicable targets.

6.2 Load Allocation (LA)

Nonpoint sources are considered to be the primary cause of sediment impairment in the listed streams. To reduce sediment from agricultural activities, road crossing, and construction activities, restoration of riparian buffer zones is recommended. For streams in the Piedmont Ecoregion where stream banks and streambed erosion appear to be the sources of sediment, instream restoration activities should be the focus to ensure

compliance with the TMDL. Further ongoing monitoring needs to be completed to monitor progress and to assure further degradation does not occur.

For those land disturbing activities related to silviculture that may occur on public lands, it is recommended that practices as outlined for landowners, foresters, timber buyers, loggers, site preparation and reforestation contractors, and others involved with silvicultural operations follow the practices to minimize nonpoint source pollution as outlined in "Georgia's Best Management Practices for Forestry (GAEPD 1999).

6.3 Margin of Safety

A Margin of Safety (MOS) is a required component of a TMDL that accounts for the uncertainty in the relationship between the pollutant leads and the quality of the receiving waterbody. The MOS is typically incorporated into the conservative assumptions used to develop the TMDL. A MOS is incorporated into these TMDLs by selecting the average sediment loading numerical target rather than the greatest allowable sediment loading value for streams that have been identified as having good habitat and biology.

6.4 Critical Conditions

The average annual watershed load represents the long-term processes of sediment accumulation of sediments in the stream habitat areas that are associated with the potential for habitat alteration and aquatic life effects.

6.5 Seasonal Variation

Seasonal variation is incorporated in these TMDLs through the use of average annual loads.

7. Recommendations

EPA and EPD have developed Implementation Plans for sediment TMDLs in other impaired waterbodies in the state. Details of this plan can be found in "*Total Maximum Daily Load Evaluation for Headstall Creek in the Savannah River Basin for Sediment (Biota impacted)"* (GAEPD, 2004). In summary, the Implementation Plan includes a list of best management practices (BMPs) and provides for an initial implementation of demonstration projects to address one or more of the major sources of pollutants identified in the TMDL.

REFERENCES

Barbour, M.T., J.Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish. Second Edition. EPA/841-B-99-002. U.S. Environmental Protection Agency, Office of Water, Assessment and Watershed Protection Division. Washington, D.C.

GAEPD, 2004. Draft Total Maximum Daily Load Evaluation for Headstall Creek in the Savannah River Basin for Sediment (Biota impacted), Georgia Department of Natural Resources Environmental Protection Division, June 2004.

GAEPD, 1999. Georgia's Best Management Practices for Forestry. Georgia Environmental Protection Division, Georgia Forestry Commission, Georgia Forestry Association. January 1999

Georgia Rules and Regulations for Water Quality Control, Chapter 391-3-6-.03, Water Use Classifications and Water Quality Standards, July 2000

Sierra Club v. EPA & Hankinson USDC-ND-GA Atlanta Div. #1: 94-CV-2501-MHS, 1998.

USDA. 1993. Georgia Watershed Agricultural Nonpoint Source Pollution Assessment - Cooperative River Basin Study. U.S. Department of Agriculture, Soil Conservation Service, Athens, Georgia.

USEPA. 1991. Guidance for Water Quality-based Decisions: The TMDL Process. U.S. Environmental Protection Agency, Office of Water, Washington, D.C. EPA/440/4-91-001, April 1991.

USEPA. 1998. Better Assessment Science Integrating Point and Nonpoint Sources, BASINS, *Version 2.0 User' s Manua*l. U.S. Environmental Protection Agency, Office of Water, Washington, D.C.

USEPA. 1999b. "Protocol for Developing Sediment TMDLs, First Edition"

USEPA. Region 4. 2001. Watershed Characterization System – User's Manual. U.S. Environmental Protection Agency, Region 4, Atlanta, Georgia.

APPENDIX A

WCS SEDIMENT PARAMETERS

Table A- 1. USLE Parameters used in Savannah River Basin Sediment Models

Parameter	South/Biger Creek		Crawford Creek		Little Crawford Creek		Shoal Creek		Copeland Creek	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
LS Factor	0.076	4.079	0.076	5.055	0.076	6.335	0.076	7.792	0.076	4.449
K Factor	0.25	0.27	0.25	0.27	0.25	0.27	0.25	0.27	0.25	0.43
P Factor	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
C Factor	0	0.12	0	0.12	0	0.12	0	0.12	0	0.12
R Factor	275	275	300	300	300	300	275	300	250	250
Weighted R Factor	275	275	300	300	300	300	279.617	279.617	250	250
Composite Erosion	0	12.328	0	7.57	0	6.056	0	7.622	0	5.391
Composite Sediment	0	3.787	0	5.951	0	5.930	0	6.493	0	3.564